Name _____

States of Matter

Your Tasks (Mark these off as you go)
☐ Assign group roles
☐ Explore physical changes
☐ Explore chemical changes
☐ Explore pure substances and mixtures
☐ Explore heterogeneous and homogeneous mixtures
☐ Propose a procedure to separate a mixture
☐ Receive credit for this lab

❑ Assign group roles

Before you continue, record your group number, then collaborate with your group and assign each person a role. Each role and a description is provided below.

Project manager (PM)	Leads the team discussion and keeps the team on task and on schedule. Make sure the final lab is submitted.
Communication Specialist (CS)	Presents answers (or questions) to the class, instructor, or other teams.

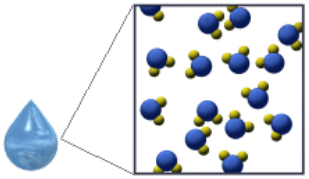
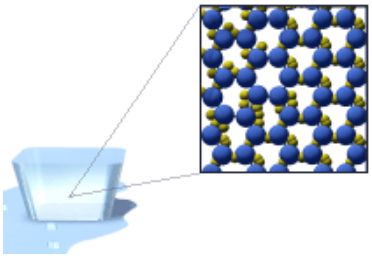
Group Number:	
Name	**Role**

❑ Explore physical changes

Physical change – the chemicals before and after are the same but the molecules have been rearranged.

- For example, sugar and water are mixed. Sugar water is still similar to both sugar (sweet) and water (a liquid) but the molecules have been rearranged.
- For example, wax is melted. Liquid candle wax is still similar to solid candle wax (same color and waxy feeling) but the molecules have spread out and move faster in the liquid.

A physical change can be represented in at least three ways as shown below,

Three different representations of freezing water		
Visual Representation		
Symbolic Representation	$H_2O(l)$	$H_2O(s)$
Molecular Representation		

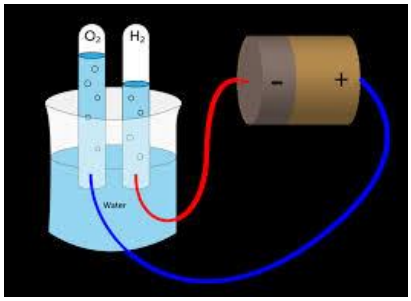
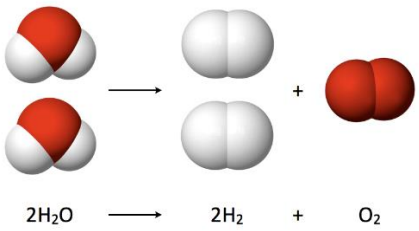
Explore your surroundings take pictures of physical changes occurring around you and insert them in the spaces below. Provide a description of the physical change that is occurring.	
Picture	**Description**

❑ Explore chemical changes

Chemical change – new chemicals are made from the chemicals before. The molecules from before have been broken down and reformed into new, different molecules after.

- For example, water is split into hydrogen and oxygen. Water molecules as a gas put a flame out. But after splitting water, the hydrogen gas molecules explode in a flame and the oxygen molecules burn in the flame. The water molecules and broken down and reformed into new, different molecules after.
- For example, a candle is burned. The wick turns from a white string to black ash. The molecules in the candle break down into CO_2 and smoke. Candle wax and the wick will burn but the black ash, CO_2 and smoke will not.

A chemical change can also be represented in at least three ways as shown below,

Three different representations of decomposing water into the elements hydrogen and oxygen	
Visual Representation	
Symbolic Representation	$H_2O(l) \rightarrow H_2(g) + O_2(g)$
Molecular Representation	

Explore your surroundings take pictures of chemical changes occurring around you and insert them in the spaces below. Provide a description of the physical change that is occurring.	
Picture	**Description**

❑ Explore pure substances and mixture

In a **pure substance**, only a single type of matter is present. In other words, only a single element or compound is present.

In a **mixture**, two or more pure substances are mixed.

Below are some examples,

Substance	Classification	Justification
Table salt	Pure substance	The chemical formula for table salt is NaCl. Pronounced, "sodium chloride". NaCl is a single compound and therefore is a pure substance.
Hand Sanitizer	Mixture	Although the main ingredient in hand sanitizer is isopropyl alcohol or sometimes ethanol (C_2H_5OH), it also contains water among other ingredients.

Explore your surroundings take pictures of pure substances and mixtures and insert them in the spaces below. For each picture provide a brief description and indicate whether the substance is pure or a mixture.		
Picture	**Description**	**Pure substance or mixture**

❑ Explore heterogenous and homogenous mixtures

Mixtures can be further subdivided into two groups: homogeneous mixtures and heterogeneous mixtures

A **homogeneous mixture** is uniform throughout and is also referred to as a **solution.** The components of a homogeneous mixture are not visibly distinguishable.

A **heterogeneous mixture** is not the same throughout. The individual constituents are visibly distinguishable.

Below are some examples of homogeneous and heterogeneous mixtures,

Mixture	**Classification**	**Justification**
Salt water	Homogeneous mixture	When salt dissolves in water, the components that make up the mixture are visibly distinguishable.
Paper clip	Homogeneous mixture	A paper clip is a type of alloy made up of different metals. A paper clip is a homogeneous mixture because you cannot visibly distinguish the elements.
Rocks	Heterogeneous mixture	Rocks are made up of minerals which are typically visibly distinguishable
Oil and water	Heterogeneous mixture	Oil and water do not mix uniformly. Because the components are visibly distinguishable, this is a heterogeneous mixture.

Explore your surroundings take pictures of heterogeneous and homogeneous mixtures and insert them in the spaces below. For each picture provide a brief description and indicate whether the substance is a heterogeneous or homogeneous mixture.		
Picture	**Description**	**Homogeneous or heterogeneous**

❑ Propose a procedure to separate a mixture

A fundamental difference between pure substances and mixtures is the ability to separate the components using physical means. **If a substance can be separated by physical means it is classified as mixture; if it cannot, it is classified as a pure substance**. Two techniques that can be applied to separate the components of a mixture are described below.

Separation by filtration

Recall that heterogeneous mixtures have particles that are visibly distinguishable (think toppings a pizza) or sand in water.

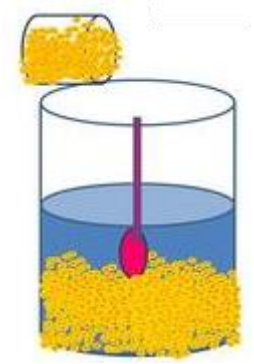


Figure 1. Sand and water

A technique for separating insoluble components from a liquid is filtration. **Filtration is a mechanical or physical process applied to separate insoluble particulates from a liquid**. For example, many acids dissolve iron but not gold. Thus, if we put our mixture into an appropriate acid, the acid would dissolve the iron and the gold would be left behind. The two could then be separated by filtration (figure 2)

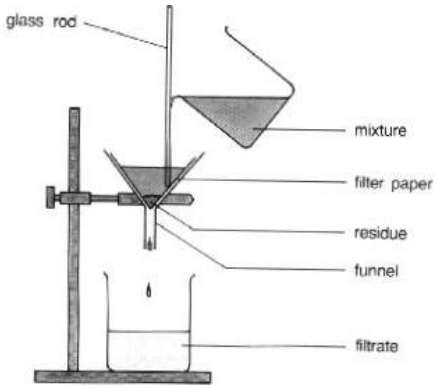


Figure 2. Filtration procedure

Separation by evaporation

Evaporation is another useful technique for separating a mixture. This process is illustrated below (Figure 2). When the saltwater solution is heated, the water evaporates, leaving the salt behind.

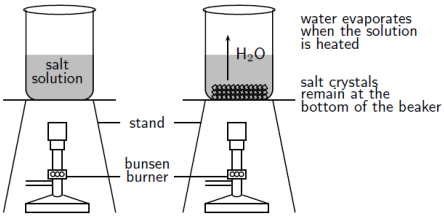


Figure 2. Separation by evaporation

Refer to your pictures of heterogeneous and homogeneous mixtures. Describe how you could separate the components of one of your heterogeneous mixtures. Describe how you could separate the components of one of your homogeneous mixtures.	
Heterogeneous separation procedure	**Homogeneous separation procedure**

Use the information below to propose a method for separating out a mixture of sand, salt, sugar, and iron.

	Sand	**Salt**	**Sugar**	**Iron**
Ethanol	Insoluble	Insoluble	Soluble	Insoluble
Water	Insoluble	Soluble	Soluble	Insoluble
Attracted to a magnet	No	No	No	Yes

❑ Receive Credit for this lab

Each group member must complete and submit their own lab to receive credit